The Critical Weed Free Period in Canola

Daniel Pouteau[1] , Rebecca Dueck[1], Steve Shirtliffe[2], Breanne Tideman[3], Charles Geddes[4], Robert H Gulden[1]

[1]University of Manitoba, Winnipeg, MB, Canada; [1]University of Saskatchewan, Saskatoon, SK, Canada;
[1]Agriculture and Agrifood Canada, Lacombe, AB, Canada; [1]Agriculture and Agrifood Canada, Lethbridge, AB, Canada

Rob.Gulden@umanitoba.ca

Background

Canola is the most important oilseed crop in Western Canada (Anonymous 2023). The critical weed free period (CWFP) defines how long into the growing season weeds must be controlled to prevent unacceptable yield losses (> 5%) (Knezevic et al. 2002). Optimized timing of herbicide applications provides several benefits including preventing unacceptable yield losses, effective weed control at the lowest cost and the potential for a reducing in the selection pressure for herbicide-resistant weeds. Growers rely heavily on glyphosate and glufosinate for in-crop weed management in canola and minimizing the selection pressure for selecting weeds resistant to these herbicides is an important production goal.

Variable germination and emergence in canola results in a broad range of stand densities within and among fields (Cavalieri et al. 2016). Crop density is an important contributor to the outcome of crop-weed interference and thereby affects The CWFP (Rosset and Gulden 2020).

Objective

Determine the effect of canola stand density and herbicide system on the Critical Weed Free Period in canola across western Canada.

Materials and Methods

In each environment, a 6 CWFP experiments (3x2 factorial design) were established in a randomized split-block design. Treatments included 3 canola target densities (30, 60 and 90 plants m^{-2}) and two herbicide systems (glyphosate and glufosinate). In each agronomic treatment, weed management was ceased at seeding, the cotyledon, the 1-, 2-, 4-, 6-, 8-leaf stages or continued season-long. Experiments were conducted at 14 environments across western Canada under natural weed populations using a canola variety resistant to both glyphosate and glufosinate over 3 years. CWFP treatments included the cessation of weed management from the seeding to anthesis and crop yield loss in response to termination of weed management and maximum weed biomass in weedy-controls were determined

In each experiment, yield loss vs. GDD_5 (beginning at seeding) was fit simultaneously in all 6 agronomic treatments to the Gompertz equation $y = ae^{-be^{-kt}}$ using PROC NLIN MIXED in SAS (Knezevic et al. 2002) and simple and main effects of curve parameters were compared using single-degree freedom estimates. The CWFP at 5% yield loss was determined for each treatment in each environment.

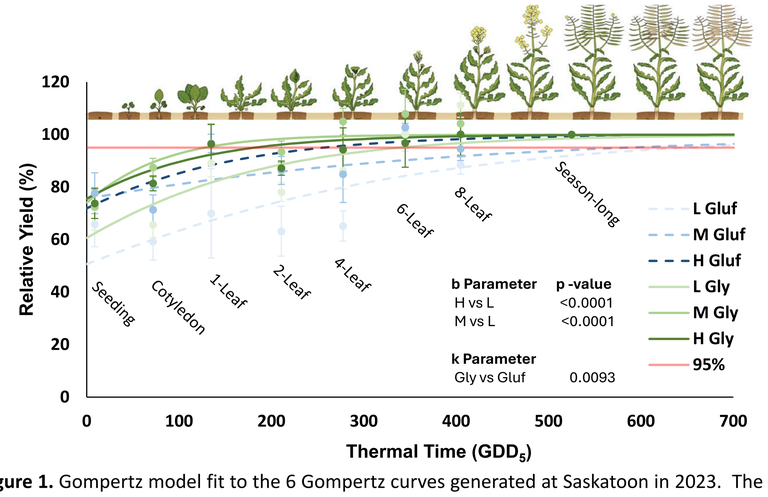

Figure 1. Gompertz model fit to the 6 Gompertz curves generated at Saskatoon in 2023. The CWFP extends to where the curves intercept the 95% yield line. Treatment means +/- one SEM and significant main effects estimates are indicated. Canola development stages adapted from www.cropscience.bayer.ca/articles/2021/determining-canola-growth-stages.

Results

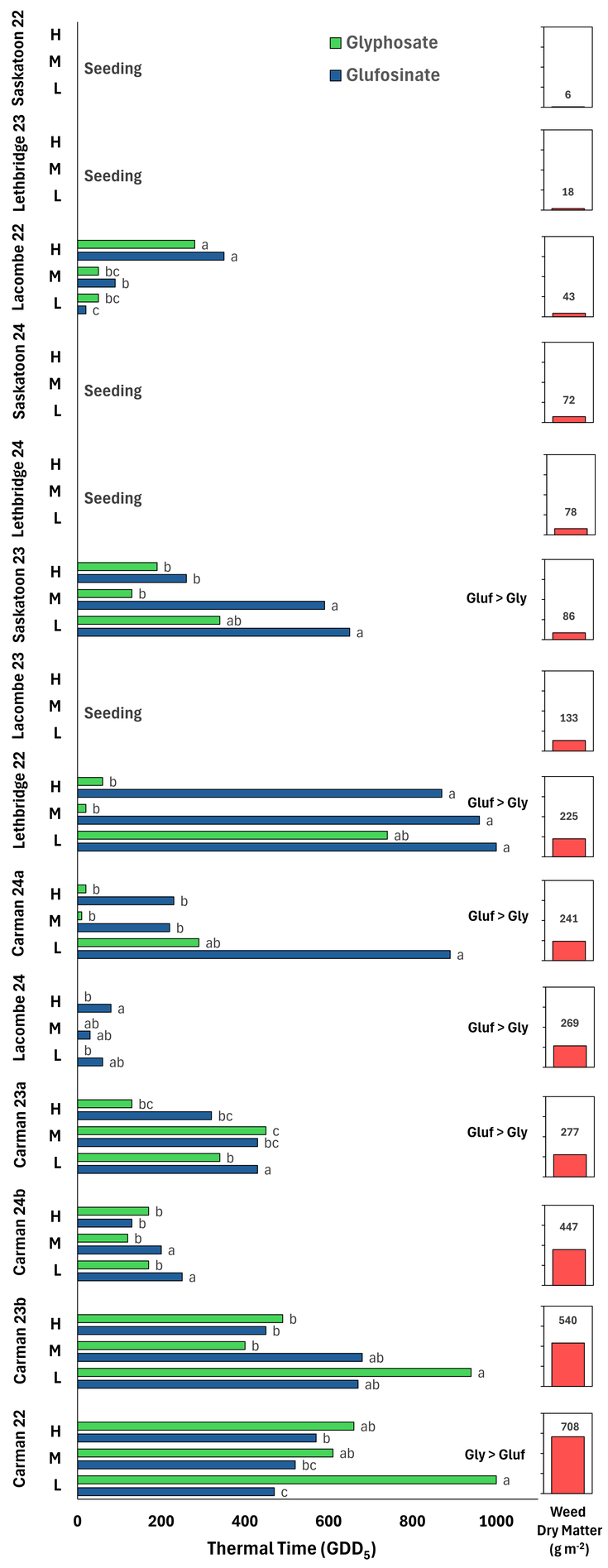

Figure 2. Duration of the CWFP at high (H), medium (M) and low (L) canola plant population densities under glyphosate and glufosinate management in all environments. Environments are ranked from smallest to greatest weed dry matter in weedy treatments. Maximum weed density is provided for each environment and bars with different letters are significantly different. Main effect difference between herbicide system are indicated where significant.

The Gompertz model (Fig. 1) successfully fit the data in 9 environments (Fig. 2). In 5 environments no appreciable yield loss due to in-crop weed interference was observed. IN these cases, the CWFP ended at seeding with no need for in-crop herbicide applications to prevent yield loss. Early cessation of the CWFP tended to be linked to inherently low natural weed populations but that was at times modified by crop yield potential (data not shown).

With larger natural weed populations or at lower canola stand densities, the duration of CWFP was longer and at times extended well into the reproductive stages (Fig. 2). On average, however, the CWFP in canola ended around the 2-3 leaf stage of canola development which was similar to previous reports (Martin and Van Acker 2000).

The duration of the CWFP was longer in the glufosinate-resistant system in 5 of 6 cases where herbicide system affected the CWFP at all canola densities (Fig. 2). This faster acting nature of glufosinate may have contributed to this which would cause in a perceived longer CWFP than treatment with the slower acting glyphosate.

Key Findings

On average, the CWFP in canola ended at the 2-3 leaf stage.

Low natural weed populations contributed to a short CWFP that in some cases required no in-crop herbicide application.

High weed populations increased the duration of the CWFP to where multiple in-crop herbicide applications may be necessary.

Low canola stand densities lengthened the CWFP, particularly when below recommended stand densities (60 plants m^{-2}).

Knowledge of canola stand densities and inherent weed populations is key for decisions on the requirements and timing of weed management in canola.

References

Anonymous (2023) Canola Production. Canola Council of Canada. www.canolacouncil.org/markets-stats/production

Cavalieri A, Harker KN, Hall LM, Willenborg CJ, Haile TA, Shirtliffe SJ, Gulden RH (2016) Evaluation of the causes of on-farm harvest losses in canola in the Northern Great Plains. *Crop Science* 56:2005-2015

Knezevic SZ, Evans SP, Blankenship EE, Van Acker RC, Lindquist JL (2002) Critical Period for Weed Control: The Concept and Data Analysis. *Weed Science* 50:773-786.

Martin SG, Van Acker RC, Friesen LF (2001) Critical period of weed control in spring canola. *Weed Science* 49:326-333

Rosset JD, Gulden RH (2020) Cultural weed management practices shorten the critical weed free period for soybean grown in the Northern Great Plains. *Weed Science* 68:79-91

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